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ABSTRACT

The data presented, illustrated with tables and graphs, include postbaccalaureate plans of physics bachelors (including trends since 1969); characteristics of bachelor's degree recipients; postbaccalaureate plans of minority group physics bachelors; type of baccalaureate plan; sources of anticipated support for first-year graduate study, 1974-77; changes in employment outlook, 1970-77; initial employment of physics bachelor's recipients, 1971-1977; use of physics training by type of employment; full-time employment of new degree recipients; starting salaries; characteristics of astronomy bachelor's recipients; and postbaccalaureate plans of astronomy degree recipients. (Author)

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AIP report

MANPOWER STATISTICS DIVISION

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1976-77 SURVEY OF PHYSICS AND ASTRONOMY BACHELOR'S DEGREE RECIPIENTS

by Susanne D. Ellis

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The number of physics bachelor's degrees granted each year ended its seven year decline and had leveled off at 4500. This survey of physics bachelors was started in the early 1960's, and three years ago its scope was broadened to include astronomy bachelors. The highlights of this report are:

- a leveling-off of the number of physics bachelor's degrees granted at 75% of its maximum in 1969
- no significant changes in the distribution of post-baccalaureate plans of physics graduates from the previous year
- a decline in the number of astronomy bachelors who plan to start graduate study in astronomy
- an increase in the number of physics bachelors who had accepted initial employment at or shortly after graduation

Figure I shows the changes in the four major postbaccalaureate plans since 1969 when the largest number of physics bachelor's degrees was granted. The greatest change over this eight-year period is in the proportion of graduates who choose "other graduate study" which increased from 16% to 28%. In general "other graduate study" refers to a field of study that is closely related to physics. **Table I** presents the numerical data on which Figure I is based and also includes a small group of graduates who are undecided about their postbaccalaureate plans. The bottom line of **Table I** is taken from the Survey of Enrollments and Degrees which reports on the total number of physics bachelor's degrees granted in the U.S.

Fig. I. Trend in postbaccalaureate plans of physics bachelors, 1969-77

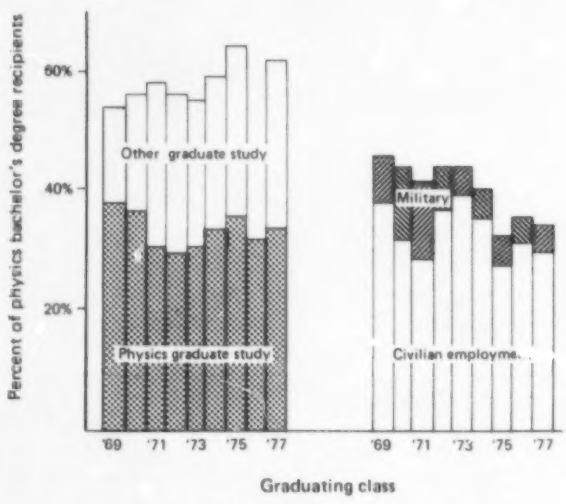

Table I. Postbaccalaureate plans of successive graduating classes of physics bachelors, 1968-77

Postbaccalaureate plans	Graduating Class 1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77
Physics graduate study	38%	37%	31%	30%	31%	34%	36%	32%	34%
Other graduate study	16	19	26	26	24	25	27	28	28
Civilian employment	38	32	29	37	39	36	28	31	30
Military service	8	12	12	7	5	4	4	4	4
Undecided	–	–	2	–	1	1	5	5	4
Total number of physics bachelor's degrees	5975	5782	5755	5282	4923	4652	4571	4487	4517

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Table II. Characteristics of physics bachelor's degree recipients, 1976–77

Characteristics	Postbaccalaureate plans: Graduate study physics	Graduate study other	Employment	Undecided	Total
Sex					
Female	8%	13%	12%	9%	10.5%
Male	92	87	88	91	89.5
Citizenship					
U.S.	95%	96%	99%	99%	96.5%
Foreign	5	4	1	1	3.5
Age					
20 or younger	3%	3%	1%	1%	1.6%
21	8	7	4	7	6.3
22	55	53	43	35	50.1
23–29	32	36	44	53	38.1
30 and older	2	1	8	4	3.9
Minority groups					
Black	1.2%	1.5%	1.2%	1.2%	1.2%
Mexican American	0.1	—	0.5	–	0.2
Other Spanish	0.2	0.1	0.2	–	0.2
American Indian	0.2	0.3	0.1	–	0.2
Asian Indian	0.4	–	–	–	0.1
Oriental	3.2	2.8	0.8	2.4	2.2
Other	2.0	1.2	–	2.4	1.4
Type of high school physics					
PSSC	31%	36%	28%	26%	31.0%
Project physics	13	10	16	17	13.4
Other	45	42	42	38	42.6
None	11	12	14	19	12.8
Type of undergraduate institution					
PhD-granting	57%	50%	42%	38%	48.3%
MS-granting	14	12	17	16	14.6
BS/BA-granting	29	38	41	46	37.1
Estimated number of bachelors	1528	1265	1543	181	4517
% distribution	34%	28%	34%	4%	100%
Number of respondents*	863	709	884	95	2551

*The response from individuals of the graduating class of 1977 was slightly lower than that from the 1976 graduates, 56% compared with 59%.

The characteristics of the graduating class of 1977 shown in **Table II** are basically similar to those of the class of 1976. Possible exceptions are a 2 percentage point increase in the proportion of graduates who had not taken physics in high school, and a slight decrease in the proportion of women graduates, reflected in the percentage that intends to start physics graduate study.

The number of physics bachelors who are citizens of foreign countries remains very small; it is the graduate physics student population that includes 20% foreign students. As far as the minority groups are concerned, 4.1% of the 1977 bachelors, compared with 5.4% of the previous graduating class, identified themselves as members of a specific racial or ethnic group listed on the questionnaire. Such small variations from one year to the next may be due to changes in attitudes about responding to a "minority question" rather than to changes in absolute numbers.

A look at the type of institutions that confer physics bachelor's degrees indicates that graduates from the 4-year colleges are more likely to enter employment directly than the other groups are. The majority of those physics majors who plan to continue the study of physics at the graduate level had their undergraduate training at PhD-granting institutions.

Table III. Postbaccalaureate plans of the members of minority groups among the physics bachelors of the class of 1977

Minority group:	Black	Mexican American	Other Spanish	American Indian	Asian Indian	Oriental U.S.	Oriental Foreign	Other
Graduate study in physics	10	4	1	2	3	12	15	18
Other graduate study	10	0	1	2	0	9	10	8
Engineering	4	–	–	–	–	4	4	6
Medicine or biophysics	1	–	1	–	–	1	1	1
Mathematics	0	–	–	–	–	1	–	1
Other science	3	–	–	1	–	0	3	–
Other	2	–	–	1	–	3	2	–
Employment	11	4	2	1	0	6	4	10
Number of job offers: 0	–	1	–	–	–	–	3	1
Number of job offers: 1	3	2	2	–	–	1	1	5
Number of job offers: 2	4	1	–	–	–	3	–	2
Number of job offers: ≥ 3	4	–	–	1	–	2	–	2
Total in survey:	31	8	4	5	3	27	29	36

The first questions on the forms sent to each bachelor deal with background characteristics one of which is a listing of six distinct minority groups; only 4% of the 2551 respondents identified themselves as members of one of those six groups—a 1% decline from last year. **Table III** shows the post-baccalaureate plans of 143 members of minority groups, 36 of whom did not specify their racial or ethnic group. Thus examining the postbaccalaureate plans of these 143 minority members and comparing them with those of all physics bachelors shows that a larger percentage of the minority members (46%) compared with 34% of all physics bachelors indicated physics graduate study as their plan. Employment or military service was the choice of 27% of the minority members, while 34% of all graduates made those choices according to **Table I**. Orientals who comprise the largest single minority group, have a high proportion of graduates who plan to continue the study of physics in graduate school.

One-third of the physics bachelors of the class of 1977 were granted arts rather than science degrees, and only half of those bachelor of arts degrees were granted by the small four-year colleges. **Table IV** includes only graduates with distinct post-baccalaureate plans, thereby excluding bachelors who are undecided, and relates those plans to the type of degree conferred.

Table IV. A science or arts degree granted to physics bachelors by type of postbaccalaureate plan, 1976–77

Postbaccalaureate plans	Type of bachelor's institution: Doctorate-granting BS	Doctorate-granting BA	Master's-granting BS	Master's-granting BA	Bachelor's-granting BS	Bachelor's-granting BA	Total respondents N	Total respondents %
Physics graduate study	43%	34%	37%	23%	31%	24%	863	35
Other graduate study	27	34	20	35	29	34	709	29
Employment incl. military	30	32	43	42	40	42	884	36
Total	100%	100%	100%	100%	100%	100%		
Respondents N	906	322	244	100	488	396	2456*	
Respondents %	37%	13%	10%	4%	20%	16%		100%

* An additional 95 graduates responded to the survey but did not specify their postbaccalaureate plans

Fig. II. Postbaccalaureate plans of the class of 1977

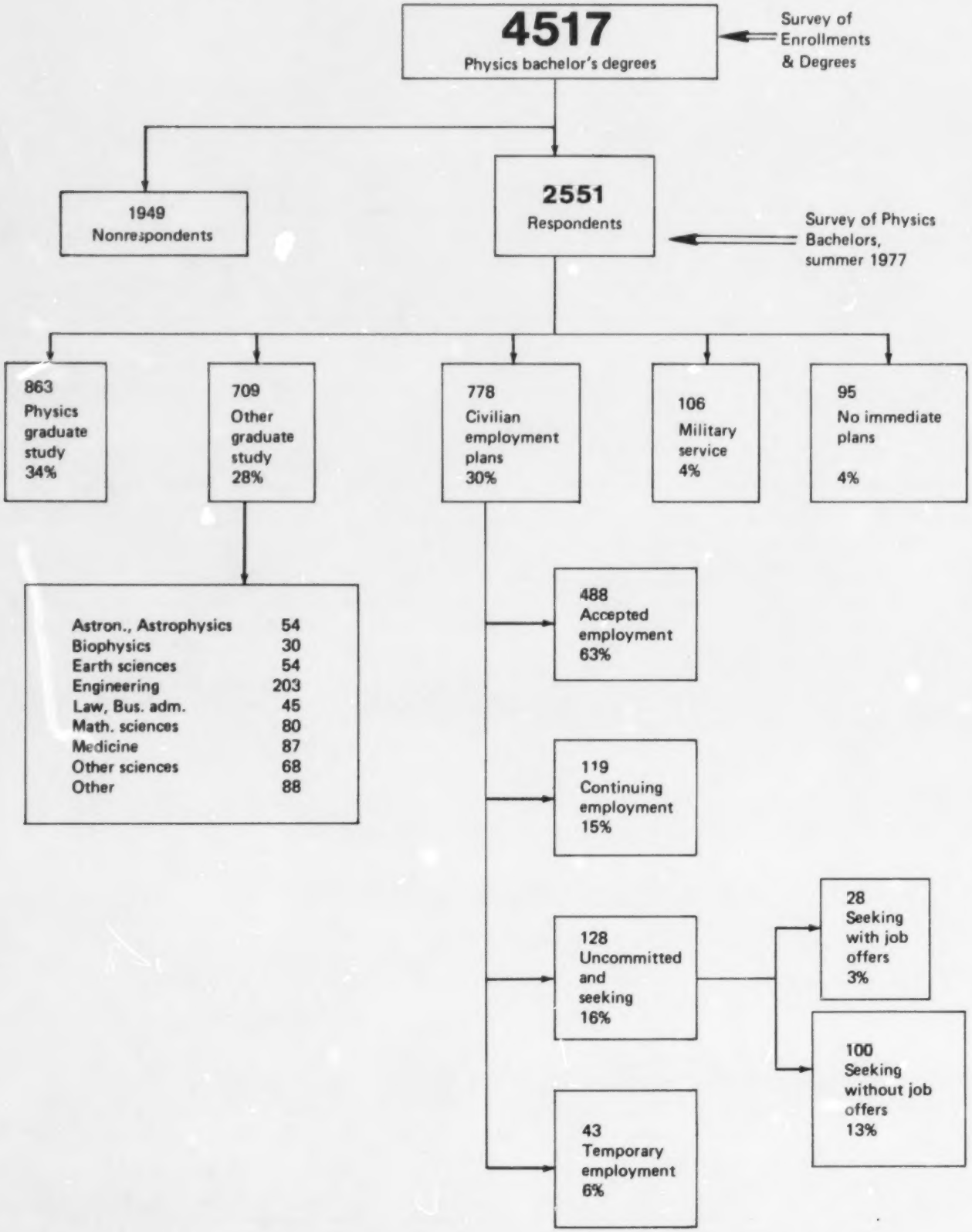


Figure II illustrates the postbaccalaureate plans of the class of 1977 in detail. While the percentage of graduates who selected "other graduate study" hardly changed in three years, their choices of disciplines changed. The proportion of bachelors interested in the earth sciences almost doubled, and the percentage entering medical schools increased from 9% to 12% in one year.

A look at the graduates interested in immediate civilian employment shows a distinctly improved situation over the previous year; 63%, as compared with 54% of last year's bachelors, had already accepted initial employment at or shortly after graduation. Furthermore, only 13% compared with last year's 19% of the employment-oriented graduates were still without job offers by the end of the summer. Another indication of an improved employment picture is the decrease in the number of graduates with "no immediate plans"; this percentage decreased from 5.1% to 3.7%.

Although that group of 95 respondents does not offer many details about what occupies them currently, 34 of them reported employment in temporary summer jobs or unpaid volunteer work; the remaining 61 graduates merely said "undecided".

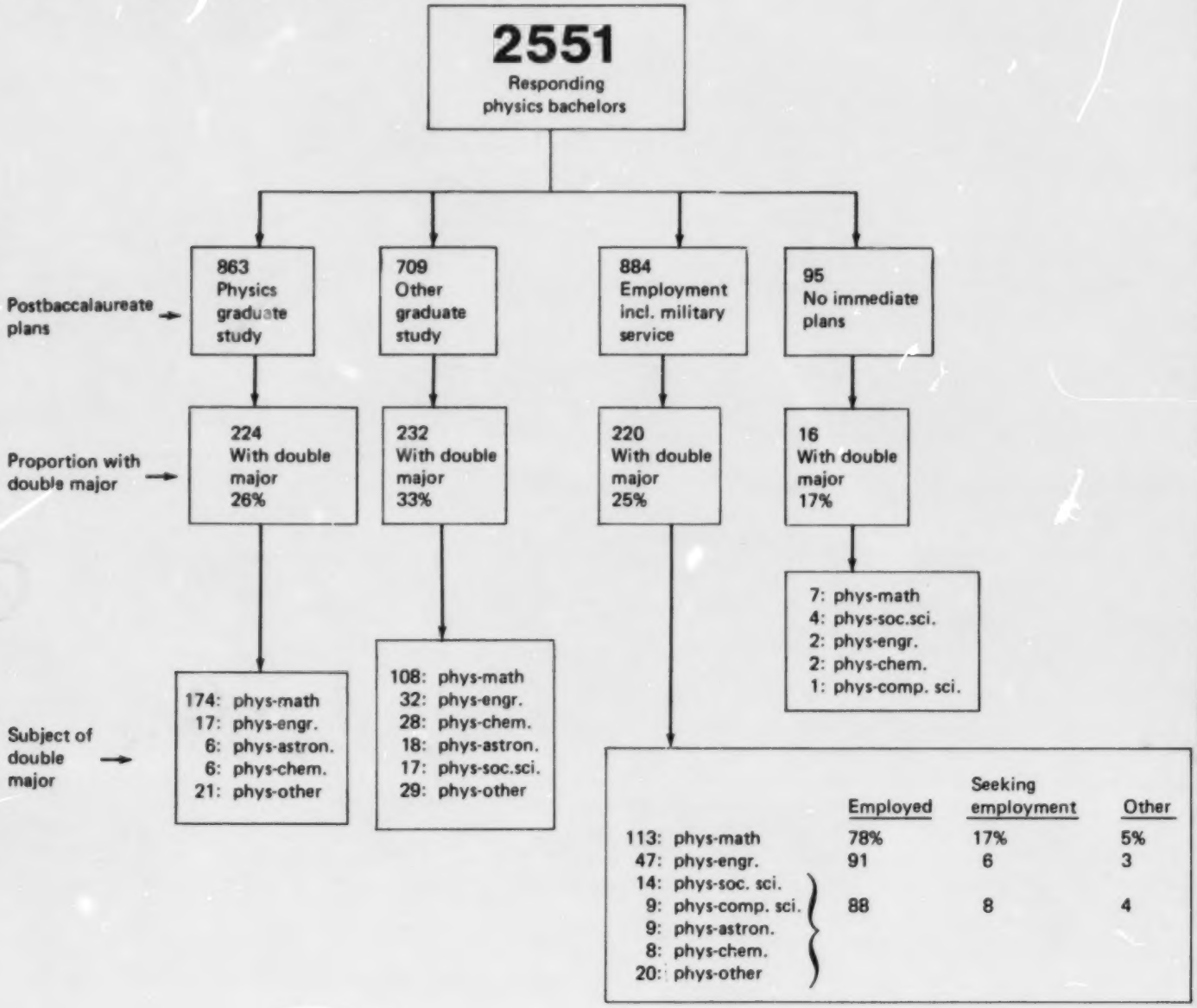
Table V. Sources of anticipated support for first-year graduate study*, 1974–1977

Sources of support	Students planning: physics gradute study				other graduate study			
	1974	1975	1976	1977	1974	1975	1976	1977
Teaching assistantship	63%	64%	64%	65%	19%	26%	25%	24%
Research assistantship	12	12	13	12	20	22	20	20
Fellowship	13	12	13	13	13	13	15	14
Employment	6	4	3	4	17	13	14	14
Family, savings, loan	5	6	6	3	23	18	19	23
GI Bill	1	1	–	–	1	2	–	2
Other	–	1	1	3	7	6	7	3
Assured	90%	89%	90%	91%	76%	78%	78%	80%
Intended	10	11	10	9	24	22	22	20
Graduate study status: full-time	98%	99%	99%	97%	96%	98%	97%	96%
Graduate study status: part-time	2	1	1	3	4	2	3	4
Total: %	100%	100%	100%	100%	100%	100%	100%	100%
Total: N	1600	1645	1440	1528	1220	1234	1260	1265

*The information was reported as of September of each academic year.

Table V points out the differences in sources of support offered to first-year graduate physics students and those beginning graduate study in other disciplines. Only 3% of the former group needed to depend on family funds, savings or loans while 23% of those interested in "other graduate study" expected to support themselves through those means. Also assistantships were offered to the two groups of graduate students in very different proportions: 77% of the graduate physics students, compared with 44% of those intending "other graduate study" reported that source of support. Very few in either group of graduate students plan to study on a part-time basis, and a high proportion of each group is assured of the reported sources of support.

Fig. III. Graduates with double majors among the physics bachelors



In recent years correspondence from students as well as faculty frequently refers to "double majors"; to get more information on physics bachelors who have elected to carry a double major we asked the 1977 graduates to comment on that choice. Of those bachelors who responded to the survey, 27% graduated with a double major. As **Figure III** shows, the highest proportion of graduates with a double major falls into the group whose plan is nonphysics graduate study, and most of those bachelors changed to that discipline which formed the double major with physics.

For all groups the combination with mathematics is the most frequent one because so many mathematics courses are required to major in physics. However, graduates with this double major among those with employment plans reported a higher than average percentage of unsuccessful job-seekers—17% for the physics-mathematics combination, compared with the average of 13% shown in **Figure II**.

Another characteristic of the "double major" graduates is the higher proportion of women among them, namely 13% compared with 10.5% women among the entire class of physics bachelors.

Table VI. Changes in employment outlook for the new physics bachelor's degree recipients, 1970–1977

Number of job offers at graduation	Summer 1970	Summer 1971	Summer 1972	Summer 1973	Summer 1974	Summer 1975*	Summer 1976*	Summer 1977
0	24%	49%	41%	26%	18%	17%	17%	11%
1	48	39	42	50	50	56	53	52
2 or more	28	12	17	24	32	27	30	37

* These figures have been revised from those presented in earlier reports to include military commitments.

The trend of employment opportunities presented in **Table VI** shows a steady improvement for successive graduating classes since 1971. The most recent graduates, the class of 1977, include the highest percentage of degree recipients with multiple offers since the late 1960's. Those graduates who reported a commitment to career or other military service were included in the data for **Table VI. Figure II** on the other hand uses civilian employment plans as its base which results in a higher percentage with zero job offers, namely 13%.

As **Table VII** shows, industry continues to employ the largest number of new physics bachelors. The reason for dividing industrial employment into two groups is to provide a category for graduates working in banks or insurance companies, who are unlikely to utilize their physics education directly; instead, these bachelors are hired for their ability to deal with numbers. That type of employment is classified as "service industry". From earlier descriptions of an improved employment market it follows that the fraction of graduates entering a service industry is decreasing. The decline in the percentage of new bachelors who accept high school teaching positions is another indication of a better job market. While a physics bachelor's degree constitutes a good preparation to teach high school physics, the comparatively low salaries offered to those teachers channel graduates into industrial employment.

Table VII. Initial employment of physics graduates with bachelor's degrees, 1971–1977

Type of employer	Percentage of employed bachelors					
	1971–72	1972–73	1973–74	1974–75	1975–76	1976–77
Industry manufacture	29%	31%	32%	25%	30%	32%
Industry service	23	23	22	25	19	16
High school	25	13	10	11	11	8
College or univ.	5	5	4	5	4	5
civilian employ.	11	6	10	9	10	7
Government career military	–	13	10	16	13	12
Res. institutes	5	3	5	4	3	7
Other	2	6	7	5	10	13
Total	100%	100%	100%	100%	100%	100%

Table VIII. Use of physics training by type of employment, physics bachelors, 1977

Newly accepted positions with selected types of employers	Use of physics training: Extensive	Little	None	Number reporting
High schools	61%	33%	6%	38
Industry-manufacture	43	46	11	184
Industry-service	37	44	19	91
Govt., Peace Corps	50	44	6	36
Research institutes	52	48	–	29
Continuing employment with selected types of employers				
Industry	30%	41%	29%	54
Govt., Res. inst.	35	60	5	21
All employers	41%	45%	14%	546
Selected work activities in newly accepted positions				
Science teaching	61%	33%	6%	56
Research & Development	68	31	1	113
Engineering	41	51	8	134
Computer programming	18	61	21	53
Skilled work	63	34	3	40
Nonphysics professional	12	60	28	54

Table IX. Full-time employment* of new physics bachelor's degree recipients, 1977

Work activity	Industry: manufacture	Industry: service	High school	Coll. or univ.	Government: civilian employ.	Government: military service	Res. inst.	Other (incl. self-employment)	Total N	Total %
Teaching: physics	–	–	36	6	4	2	–	2	50	8
Teaching: other	–	–	4	–	–	–	–	–	54	1
Res. & dev.	59	16	–	12	13	9	29	8	146	22
Engineering	92	36	–	3	15	33	5	12	196	30
Computer programming	18	33	–	5	6	2	4	3	71	11
Management training	3	–	–	–	–	9	–	2	14	2
Nonphysics professional	20	14	–	1	9	19	1	11	75	11
Skilled	17	12	–	5	4	10	3	4	55	8
Unskilled, supervisory & nonsuperv.	3	–	–	–	–	3	–	6	12	2
Other	1	6	–	–	–	19	–	9	35	5
Total N	213	117	40	32	51	106	42	57	658**	
Total %	32	18	6	5	8	16	6	9		100%

* The employment of these 658 new graduates includes both newly accepted positions as well as those in which graduates are continuing.

** An additional 55 bachelors were employed but did not report their work activities and are consequently not included in Table IX

Another way of looking at an improved employment market is in terms of the proportion of bachelors who find positions that make use of their physics education. **Table VIII** analyzes that aspect by specifying three degrees of utilization: extensive, little, or none. When all 546 employed graduates who responded to that question are grouped together, only 14% described their employment as "making no use of their physics training". This percentage compares favorably with the 19% that fell into the category the year before. Where industry as an employer is concerned, a noticeable shift occurred from "little" to "extensive" use of physics; over 50% of the bachelors in the class of 1976 reported "little" use of physics training, while **Table VIII**, in describing the class of 1977, shows only 46% and 44% in that category for industrial employment. When all newly-accepted positions are compared with those in which graduates are continuing, the former group invariably includes a higher proportion of positions in the "extensive use of physics" category, because the applicants hold physics degrees instead of being undergraduates when they started employment.

The lower portion of **Table VIII** does not include bachelors who continue their employment; it lists the most frequent work activities of the newly-accepted positions.

The work activities presented in **Table IX** show few changes from the previous year with the exception of teaching which declined from 16% to 9%. The 106 bachelors listed under "military service" included both career military and those with other military commitments. Nine graduates who joined the Peace Corps were included under civilian employment with the government.

For a short time during the early 1970's requests for salary information appeared to decline as more attention was focused on the extent to which openings were available for new graduates. However, by 1977 salary data resumed its first place among the types of data that are in demand. Both employers and new graduates consider it important to evaluate and compare salaries on a national scale. **Table X** lists the median monthly salaries offered by five types of employers to men and women. Since the median salary reported by 64 career military graduates was identical to that reported by those with other military commitments, the two groups were added together, thereby comprising 18% of the total. In comparison with the class of 1976, the gap between starting salaries paid to men and women appears to be closing; on the other hand only 61 women of the class of 1977 reported their salaries. For example the $1150.– paid by service industries is based on only five women.

The overall starting salaries for chemistry bachelors were $95– lower than those reported by the physics graduates. These data were taken from the "1977 Report of Chemists' Salaries and Employment Status" published by the American Chemical Society.

Table X. Starting salaries for new physics bachelors, 1977

Type of employer	Men (472 reported salaries)		Women* (61 reported salaries)		Total (533 reported salaries)	
	Distr. by employer	Median monthly salary	Dist. by employer	Median monthly salary	Distr. by employer	Median monthly salary
Industry-manufacture	31%	$1170	51%	$1160	32%	$1168
Industry-service	17	1115	8	1150	16	1117
High school	7	785	16	765	8	780
College or university	5	845	7	800	5	838
Government — civilian	7	1035	5	900	7	1024
Government — military	18	890	–	–	18	890
Res. institute	6	1075	5	1000	6	1068
Other	9	1000	8	1000	8	1000
Total	100%	$1055	100%	$1050	100%	$1055

* Includes accepted and continuing employment

ASTRONOMY

The astronomy bachelors of the class of 1977 formed the third successive class to have contributed information to our Survey of Bachelor's Degree Recipients. Each year the number of respondents increased, which may or may not indicate a rising trend in the number of astronomy bachelor's degrees granted, because we are still uncertain of the total number of degree-granting astronomy departments. At this time we estimate the percentage response that the 120 bachelors represent, to be above 60%.

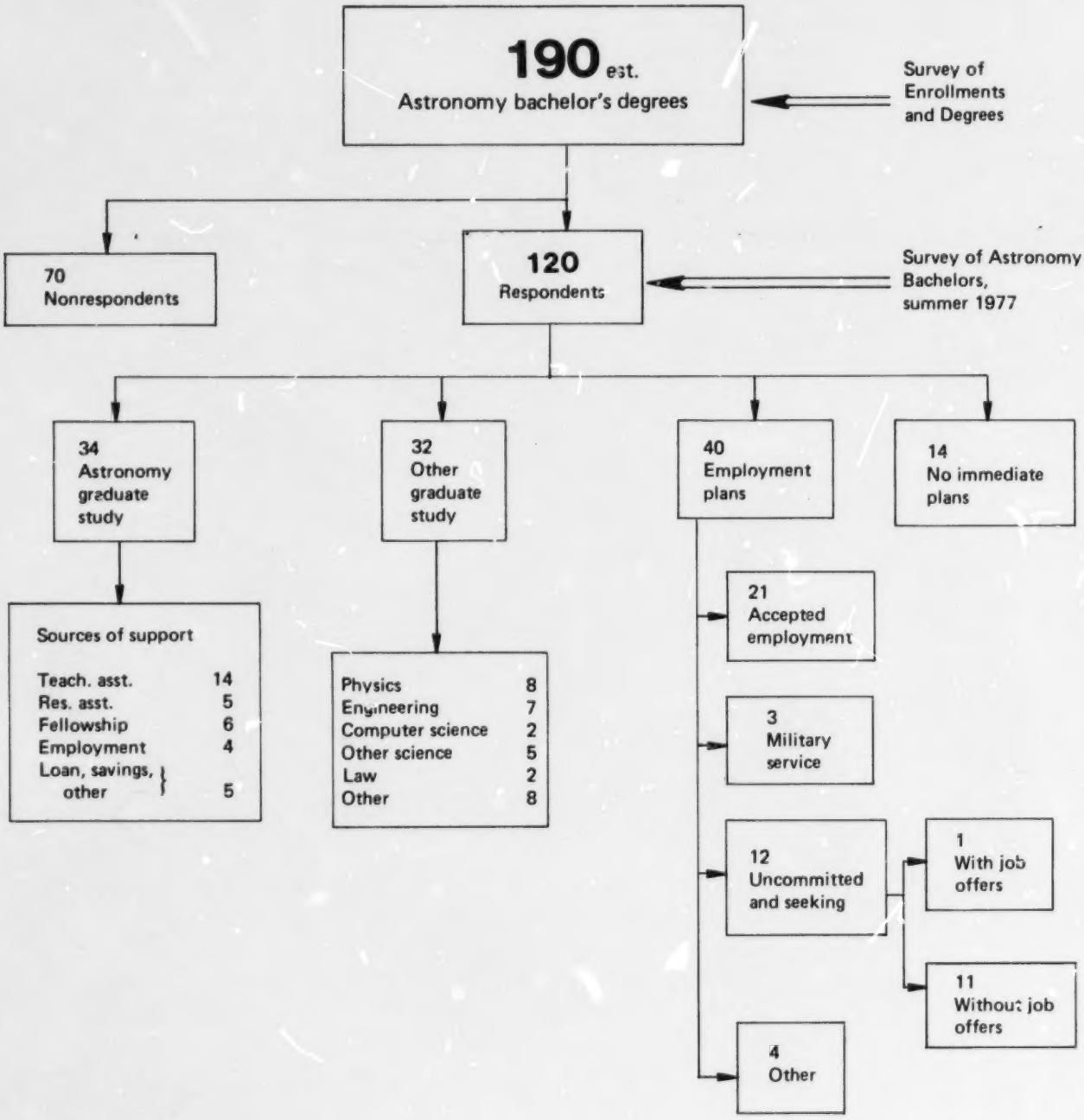
Table XI divides the respondents into four groups according to their postbaccalaureate plans and analyzes six characteristics on that basis. The largest group of graduates is the one with employment plans. The most noticeable change from the previous year, which had 110 respondents, is the decline in the number of bachelors whose plan is to continue the study of astronomy in graduate school—46% of the class of 1976 compared with 28% of the class of 1977.

Astronomy undergraduates include very few foreign students, or members of minorities; there were none of the latter among the 120 respondents. The graduates' age distribution is similar to that of the physics bachelors, but a much greater proportion of the astronomy undergraduates were enrolled at PhD-granting institutions than the physics students,—74% compared with 48%.

Table XI. Characteristics of astronomy bachelor's degree recipients, 1977

Characteristics		Postbaccalaureate plans					
		Astronomy graduate study	Other graduate study	Employment plans	Undecided	Total N	Total %
Sex	Female	3	6	4	2	15	13
	Male	31	26	36	12	105	87
Citizenship	U.S.	33	32	40	14	119	99
	Foreign	1	–	–	–	1	1
Type of H.S. physics	PSSC	10	10	11	4	35	29
	Project physics	2	4	4	1	11	9
	Other	18	15	17	9	59	49
	None	4	3	8	–	15	13
Age	21 or younger	4	4	1	1	10	8
	22	17	17	16	9	59	49
	23–25	12	11	16	4	43	36
	26 or older	1	–	7	–	8	7
Type of degree	BA	18	8	22	7	55	46
	BS	16	24	18	7	65	54
Type of bachelor's institution	PhD-granting	21	27	32	9	89	74
	MS-granting	9	1	5	1	16	13
	BA/BS-granting	4	4	3	4	15	13
Total	N	34	32	40	14	120	
	%	28	27	33	12		100%

Fig. IV. Postbaccalaureate plans of the class of 1977



The flow diagram of **Figure IV** elaborates on the postbaccalaureate plans presented in **Table XI.** Since the number of graduates involved is so small, no percentages are shown in **Figure IV;** there are eleven astronomy bachelors, out of 40 with employment plans, who had not found positions before or immediately after graduation. Also, compared with the class of 1976 the proportion of graduates without specific plans has increased; there were only 5 among 110 bachelors in the previous year.

Table XII. Use of astronomy education by type of employer for astronomy bachelors, 1977

Type of employer	Use of astronomy education			Total
	Extensive	Little	None	
College or university	4	1	2	7
Industry	1	5	3	9
Government	–	2	2	4
Other	3	–	1	4
Total	8	8	6	24

Although the numbers are small, industry employed the largest number of astronomy bachelors both in 1976 and in 1977. The three graduates who entered military service are included under government in **Table XII.**

One third of the astronomy bachelors indicated that they carried a double major, and for all but two of the graduates it was physics.

Additional publications available from the Manpower Statistics Dividion are:

Graduate Student Survey
Employment Survey
Survey of Physics and Astronomy Enrollments and Degrees